[0017] FIG. **6** shows a simplified cross section view of an assembly according to some embodiments.

[0018] FIG. **7** shows a simplified cross section view of an assembly according to some embodiments.

DETAILED DESCRIPTION

[0019] FIG. **1** shows a longitudinal cross-section view of a cable **100** with integrated strain relief according to some embodiments. Cable **100** can be an electrical cable of arbitrary length and can have, for example, a cylindrical cross section. Cable **100** can have a core **102** that includes one or more conductive wires, which may be insulated from each other. The conductive wires can be, e.g., copper wire or the like and can have any gauge desired. Any number of wires can be included. For example, cable **100** can be usable as a USB cable having four wires to conduct power, ground, and a pair of differential data signals. The particular number, arrangement, and gauge of the wires in cable **100** can be varied as desired.

[0020] Cable **100** also has an outer sleeve **104** that can be made of polymers such as a thermoplastic elastomer (TPE), a thermoplastic urethane (TPU), or a thermosetting plastic. Numerous examples of suitable polymers are known in the art. Different longitudinal sections **111**, **112**, **113** of sleeve **104** can have different stiffness (or resistance to bending); in FIG. **1**, stiffness is indicated using gray scale, with black corresponding to highest stiffness and white corresponding to lowest stiffness. Central section **111** has a low stiffness, end sections **112** have a high stiffness, and "transition" sections **113** have a variable stiffness that gradually transitions between the high stiffness of end section **112** and the low stiffness of central section **111**.

[0021] Various metrics can be used to define stiffness. For example, minimum bend radius, defined as the smallest radius at which the cable can be bent without a kink, is one well-known measure of cable stiffness, and a minimum bend radius can be defined relative to the cable diameter. Increasing bend radius corresponds to increasing stiffness. Depending on the particular cable design, the minimum bend radius might be e.g., 8 to 12 times the cable diameter. In some embodiments, the stiffness of central section **111** may constrain the minimum bend radius.

[0022] End sections **112** can be significantly stiffer than central section **111**. For example, end sections **112** can be stiff enough to provide strain relief when ends of the wires of core **102** are connected to a device. In some embodiments, end sections **112** can be rigid, or end sections **112** can have a minimum bend radius that is 10 or 100 (or more) times the minimum bend radius of central section **111**. Transition sections **113** can have a stiffness that increases monotonically from the low stiffness of central section **111** to the high stiffness of end section **112**, thereby providing a smooth transition between rigid and flexible sections of cable **100**.

[0023] In some embodiments, sleeve **104** having variable stiffness can be manufactured using an extrusion process. For example, the polymers used to make sleeve **104** can include a mixture of a stiffer material and more flexible (also referred to as softer) material. By varying the relative proportion of stiff and flexible materials as a cable is extruded, regions of greater or lesser stiffness can be created. For instance, end section **112** can have a greater amount of stiff material than flexible material so that end section **112** can be substantially rigid to resist bending of cable **100**. Central section **111** have a greater amount of flexible material than stiff material so that central section **111** can be substantially pliable to allow bending of cable **100**. Transition section **113** can be a region of cable **100** where stiff and flexible materials gradually vary in relative concentration between end section **113** and central section **111**. For instance, transition section **113** can be a region of cable **100** where the amount of stiff material decreases from the amount used in end section **112** to the amount used in central section **111** while the amount of flexible material increases from the amount used in end section **112** to the amount used in central section **111**. In some embodiments, the amount of stiff material varies inversely with the amount of flexible material.

[0024] In some embodiments, instead of using a mixture of materials, a cable sleeve having variable stiffness can be a multilayer sleeve incorporating two (or more) layers of different stiffness. FIG. **2** shows a longitudinal cross-section view of another cable **200** with integrated strain relief according to some embodiments. Like cable **100**, cable **200** can be an electrical cable of arbitrary length and can have, for example, a cylindrical cross section. Cable **200** can have a core **202** that includes one or more conductive wires, which may be insulated from each other. The particular number, arrangement, and gauge of the wires can be varied as desired.

[0025] Cable **200** also has an outer sleeve **204** that can be made of polymers such as a thermoplastic elastomer (TPE), a thermoplastic urethane (TPU), or a thermosetting plastic. Numerous examples of suitable polymers are known in the art. Similarly to cable **100**, different longitudinal sections **111**, **112**, **113** of cable **200** can have different stiffness, with central section **111** having low stiffness, end sections **112** having high stiffness, and sections **113** having a variable stiffness that gradually transitions between the high stiffness of end section **112** and the low stiffness of central section **111**.

[0026] In cable **200**, the regions of different stiffness are created by forming outer sleeve **204** from two layers of material having different stiffness. For example, outer sleeve **204** can be a multi-layered sleeve that includes two layers: a soft layer **211** made of a material that is relatively flexible (small minimum bend radius) and a stiff layer **212** made of a material that has a structural rigidity that is greater than that of soft layer **211** (high minimum bend radius). In some embodiments, the relative thickness of stiff layer **212** and soft layer **211** can be modified to create three regions of sleeve **204**: a stiff end section **112**, a flexible central section **111**, and a transition section **113**. As shown, in end section **112**, stiff layer **212** is thicker than soft layer **211**, so that end section **112** can be substantially rigid to resist bending of cable **200**. In central section **111**, soft layer **111** is thicker than stiff layer **212**, so that central section **111** can be substantially flexible to allow bending of cable **200**. Transition section **113** can be a region of cable **200** where stiff and soft layers **212** and **211** gradually vary in relative thicknesses between stiff end section **112** and flexible central section **111**. The total thickness of stiff layer **212** and soft layer **211** can be constant along the length of cable **200**, so that when stiff layer **212** increases in thickness, soft layer **211** decreases in thickness, and vice versa. Thus, within transition section **113**, the thickness of stiff layer **212** decreases from end section **112** to central section **111** while the thickness of soft layer **211** increases from end section